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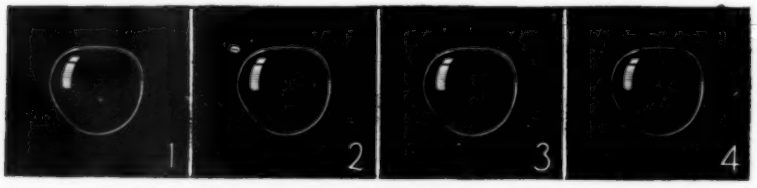

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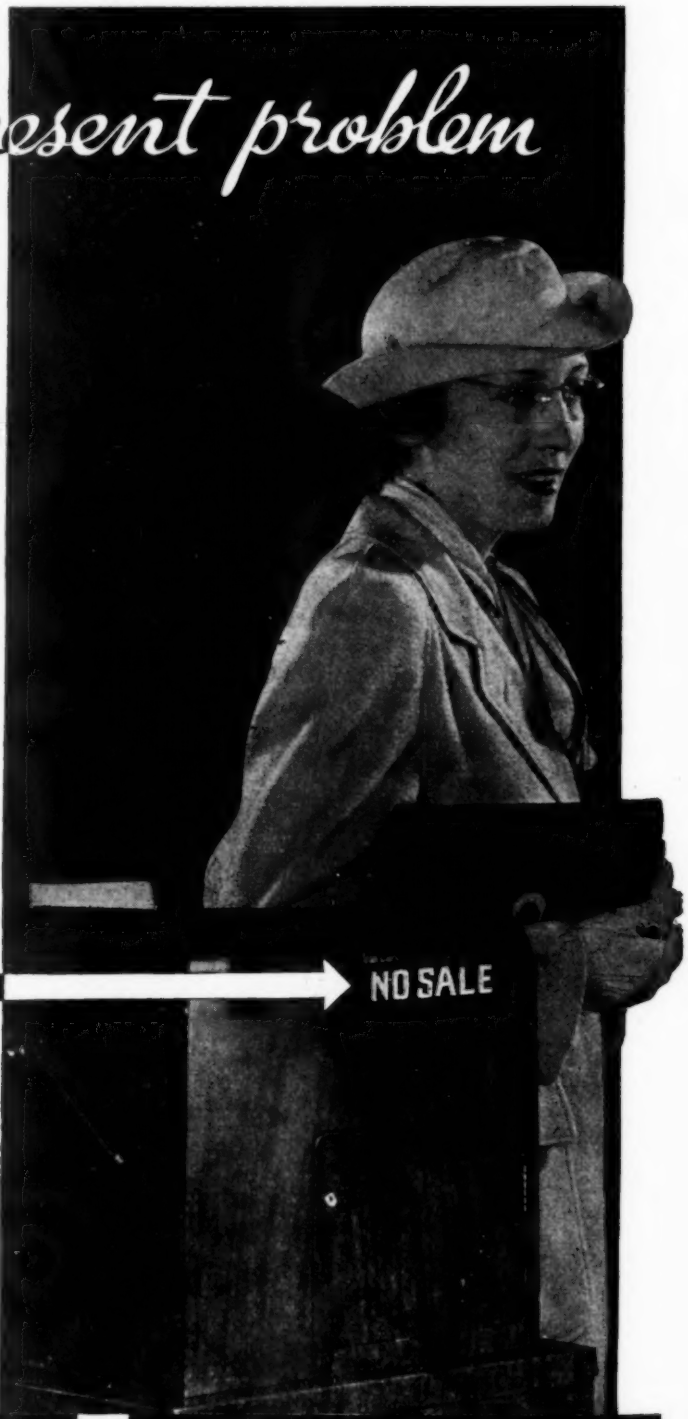

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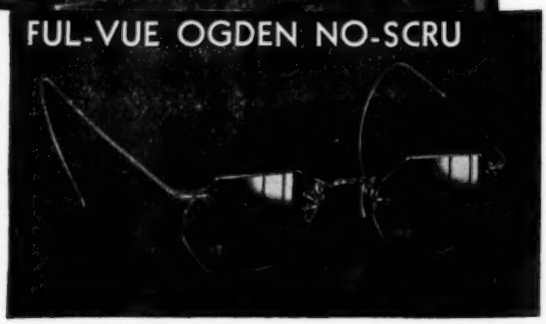

AMERICAN JOURNAL OF OPTOMETRY

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A MID-LIFE IMBALANCE PHENOMENON*

Hammond S. Horton, B.Sc., A.O.
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There is an interesting type of myologic imbalance which is found in men between 40 and 70 years of age about which I have intended to write a few lines for some little time. It is one more valid reason why practitioners who are not in the myologic field must prepare for this type of work in order to give comfort and efficient vision to the large percentage of his cases who may need myologic training in varying degrees of intensity. To not realize that these cases need something more than the mere need of an ametropic correction is to fail utterly in giving these persons that which they sought—a comfortable, efficient visual apparatus.

The practitioner must realize that to correct an unbalanced visual apparatus may mean a correction in lens form for an ametropia, or a neuro-myologic treatment for an error of muscle tone, nerve flow, correlative control, or retinal inefficiency. There is a whole lot more involved than the mere investigation and correction of an error of refraction. This type of case which I am mentioning in this paper is just one of many who will not derive comfort or efficiency of this complicated apparatus with a pair of lenses.

The reader will recall that he is dealing with not only the composite refractive power of the optical system of the eyes, but also with six pairs of extrinsic ocular muscles. The nerve flow to all these muscles and to the two pairs of intrinsic non-striated muscles as well must be perfectly graded and coordinated in order that the visual function may operate effectively.

The two eyes must also function as a single organ, not as two organs, thus the desperate need of this delicate adjustment of nerve control.

In review, then, the nerve flow to the apparatus comes by way of the oculomotor, trochlear, and abducens nerves, and the sympathetic and parasympathetic systems.

Each nerve arises in a group of nerve cells which is known as its nucleus of origin. In the brain substance there are longitudinal fiber systems which make interconnection, correlation and coordination possible.

*Submitted for publication May 24, 1934.

The nucleus of the Oculomotor nerve is the most complex of all these bodies we are now considering. It is a composite group of individual nuclei. There are eight different parts, each of which is believed to innervate a single muscle in the ocular apparatus. There are cells which control the skeletal muscles of the extrinsics, and also cells which compose the Edinger-Westphal branch which control the smooth muscles of the ciliary and iris. The nuclei of the two sides are connected across the midline, also with the sensory paths of the spinal cord, with the cerebellum through the superior cerebellar peduncle, with the voluntary tracts of the cerebral hemispheres through the pryamidal tracts, with the ventral longitudinal bundle and tecto-spinal tracts running down into the spinal cord, with the posterior longitudinal bundle running upward to the thalamus, with the occipital lobe of the cerebral cortex, and with the superior colliculi by colliculo-oculomotor fibers.

These are not all of the ramifications of the interconnections of this important nucleus. The large nucleus of Perlia which is situated medially in the oculomotor nucleus is well developed in those persons with good convergence according to Tilney and Riley. The nucleus also receives fibers from the opposite nucleus of the Abducens nerve through the posterior longitudinal bundle for the purpose of aiding in the synergic and harmonious movement of the two eyes in lateral excursions.

The nucleus of the Trochlear nerve lies immediately behind that of the oculomotor nerve in the gray matter surrounding the aqueduct of Sylvius in the substance of the midbrain. It is a simple nucleus and the fibers turn opposite to the direction assumed by the other cranial nerves, with the result that the nerve emerges from the dorsal aspect of the brain stem, just behind the inferior colliculi, and above the line of the anterior medullary velum. The nerve then courses laterally around the brain stem and finally is seen on the ventral aspect curving around the cerebral peduncles.

The abducens nerve arises from its nucleus which is situated in the substance of the pons. It passes through the brain substance to emerge at the lower border of the pons.

In this short paper it is impossible to give the reader a complete picture of the mechanism. However, the preceding paragraphs do give a basis for the material on this myologic phenomenon we are discussing. It should be visualized that these nuclei of origin and their interconnections, and the connections with other brain parts associated with both motor and sensory functions elsewhere in the body systems provide a means whereby not only the visual apparatus may be finely coordinated and correlated, but also may become subject to distortions in a reflex manner from some other distortion which is of a primary nature.

In men after the age of 40, then, it is believed that there is some physical basis for a reflex distortion of this type, although it is many times questionable. The color fields rarely show any great involvement. A visual upset of this character would be expected to be due to a systemic toxic upset. However, this in most cases is negative. It is also a truth

which we are beginning to realize that the absence of color field indications does not preclude the possibility of systemic upsets. The average medical examination cannot give in completeness the material we so earnestly desire on these cases. Their ability to ferret out functional and organic anomalies is so many times greatly limited. These conditions are so elusive that the methods for the investigation of many conditions have not as yet been determined.

We may be dealing with a primary ocular condition. By ocular I mean to include the entire visual apparatus from the globes and their muscular apparatus through the optic nerves and tracts, into the primary visual centers, their connections here with other brain parts, and thence on back through the optic radiations into the cortex of the occipital lobes of the cerebral hemispheres.

Somewhere there is a cause for this odd type of imbalance. Why should it appear in men only? Only time will answer that question. The coordination of a binocular visual apparatus is completely lost. We do know that fact. It may be that there is a glandular disorder at this time of life which is responsible for the anomaly, and it may be a toxic phenomenon, although as previously shown, this is questionable. (There is a prostate gland involvement at this time of life). The disorder of the apparatus does not reach the stage of actual strabismus. If it did do this there would certainly be less confusion to the patients.

The clinical signs, then, are in their most complete form, the loss of single, binocular vision in which the patient cannot hold either a distance or a near target singly. There is no combination of prisms which will allow single vision. The fusion centers in the occipital cortex are unable to provide the superimposition of the images so that the higher psychic vision which man has developed can result. There may be something to this factor from a standpoint of etiology. There is also that type which has diplopia at near, and that which has diplopia at distance only.

The profession has long been aware of the fact that there is a type of imbalance reaching the actual stage of a squint which occurs much the same as this imbalance we are discussing. It has been believed that this condition is of toxic origin, and with some exceptions the squint responds readily to myologic treatment. It might be that the midlife imbalance is the forerunner of the actual squint, although such does not seem to be the case clinically. Most of the actual squinters complain of sudden diplopia, while those with the loss of coordination and diplopia but no measurable squint complain of a gradual onset which persists over a long period without a squint actually appearing in this time.

It seems to me in the light of this material we have gathered that the two midlife conditions may be due to the same causes, however, the imbalance type does not seem to eventually resolve itself into the squint type. A lot more data on this subject will undoubtedly be enlightening.

Treatment of these cases with alternate base in and base out corrective work restores the function to normalcy. If there is any vertical

imbalance, then it is advisable to give vertical prism corrective work in the direction of the low vertical ductions. This treatment would then consist of base out, followed by the vertical, this followed by the base in exercise. This sequence has been found the best because the most highly stimulative comes first, the others lessening in intensity, so that the relaxation type will aid in minimizing the harmful effects of the stimulative type. I have found that a large target such as the Squint Korector is the best to start this work, but after a small range of single, binocular vision has been restored, almost any effective instrument can be employed.

The treatment is continued until there are good ductions in every direction, at least 40 prism diopters of adduction for 6 meters, 8 of abduction with good relaxation at the near test as well, and a balanced and equal vertical duction for both distances.

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MECHANICAL EXPERIMENTS TO REPRODUCE THE FUNCTIONS OF THE EXTRA-OCULAR MUSCLES*

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In a gross sense, it has for a long time seemed to us that the motor mechanism of a pair of eyes could be analyzed, and that the several versions mathematically demonstrated so that the whole problem would be very readily understood. With the four versions under control of the four recti, and these muscles working in harmony, it would appear that a definite amount of tonicity, or of neural innervation, would account for a corresponding degree of version. In a measure, these facts are true, but in other measure, the problem has shown definite complexity, several factors of which leave us very much up in the air.

Some of these disturbing factors have come into the problems presented because of our lack of knowledge of precisely what the superior oblique muscle is intended to do, and still more indeed by that of the relatively very short inferior oblique. Both these muscles exert, in the Primates and Man, a direction of tractive force which for practical purposes we may say is at right angles to the direction of the several recti, or their combined functions. In some of the primitive types, these muscles are so attached that they have a positively forward-oblique traction, nearly, or in a very definite sense contra to the combined recti.

There seems a very great misconception by all writers upon the subject that the opposite recti are truly antagonistic, that for instance when the internal rectus turns the globe inward the external rectus acts like a rubber band, and is stretched, is pulled, is loaded with an extra effort by an amount precisely equal to the tensional increase of the internus. Nothing I believe could be further from fact.

To mechanically illustrate this point, and others, the writer has prepared a mechanical model to simplify these factors. The globe on this model is rotated to the right by a spring which corresponds to one muscle, this being energized by a cord, representing the nerve supply. This cord is attached to one side of a rotating element of the same side as the globe. At the opposite of the globe is a corresponding spring and cord, muscle and nerve, attached to the corresponding side of the rotor.

*Submitted for publication March 12, 1934.

Now if the globe is caused to turn to the right by turning the rotor to a degree, it is apparent that the opposite neuro-muscle is not *stretched* by that amount, but on the other hand is truly *released* by the amount, the consequent action of which is that no added pressure results upon the globe across its diameter, but that it is under the same pressure in its *extreme* rotated position, turned in either direction as when in the frontal position. The keratometer has confirmed this fact many times, that no astigmatic corneal distortion occurs.

In the ocular muscles, the so-called normal-tonus is inhibited from action by an amount precisely equal to the innervation of the contractor, in other words IN-nervation=EN-nervation, hibition equals inhibition. It would exhibit poor mechanics for Nature to have devised an instrument which constantly wore itself out by keeping two elastic bands balanced against each other, with the consequent waste of energy on both sides when either were pulled by the slightest amount. While the model exhibits this fact in a satisfactory manner, it is also possible to build an electrical model in which the muscles would be replaced by electro-magnets, energized by a current which passed through a duo-pole rheostat so hooked up that when the control handle is turned in one direction it would reduce the current of one magnet an amount precisely balanced by the increased flow into the one more energized. There would be expended in such a model the same current amperage when the globe was turned to the extreme right or left as would flow when in the mid-position.

Those who are interested in the electro-mechanics of the human body can find no more fertile or intriguing field for study than the many text books now available. Nobel M. Eberhart says in his Working Manual of High Frequency Currents: "From an electro-physical standpoint, the human body is the most delicate, intricate, and wonderful apparatus of which we have any conception. Within its structure are contained electric generators, converters, vibrators, rheostats, condensers, resonators, inductances, transformers, conductors, insulators, collecting and dispersing electrodes. It develops electromotive force producing volts, amperes, and watts. The skin presents a resistance of thousands of ohms. The body is full of primary cells connected in series and multiple, and develops continuous, alternating, sinusoidal, static, inductive and oscilatory currents. Its electrolytes contain anions and cathons. Its diathermic apparatus converts mechanical energy into heat. The body as a whole exhibits polarity which is usually positive but may be changed to negative by surrounding objects. It receives electrical discharges and disperses them. It has electric circuits, open and closed. It not only possesses every device known to electrical science but many details of construction and activity which we do not understand."

For countless years we have been instructed that there were two kinds of muscles, the striped and the unstriped, the voluntary and the involuntary, one which the willed effort could energize or inhibit, the other which the will could not effect. Rather recently there has developed

a thought that there is also perhaps one other type of muscular fibre, the red fibre, rich in sarcoplasm, of small thickness, and capable of tonic contraction in distinction to the ordinary fibre capable of the usual contraction. It has rather recently been found that some of the skeletal muscular fibres have a double nerve supply derived from unlike nerve cells. The fact is that very little is yet known about the origin, activity, intensity, frequency, and purpose of the neural energy delivered to the musculature.

Nor are we much better off in our understanding of the muscles or their functioning. Referring now to the recti, and more particularly to the interni, we have roughly supposed that these were simple in construction, that they were energized from one source, whereas the facts which they exhibit to us have always proclaimed quite the contrary. One function of the internal rectus has been that of horizontal rotation in conjunction with the externus in such hookup that one relaxed while the other contracted an equal amount. This movement is of course common in reading across the page. But to this function must be added another, that of a definite convergence factor which could not reasonably originate from the same neural centre as that which governs rotations. Biologically we are well aware of the fact that the factor of convergence is recent, that it has only been acquired by primates and man, and that indeed in a considerable percentage of humans it is extremely inadequate, is slow of development, is laggard in activation, and readily slips out of gear.

In the model just completed I have attempted to exhibit these two, very unlike, although measurably associated functions by means of cords originating from different sources, although both attached to the same muscle-spring effectors. One will readily see that the eyes swing from side to side in unison with their direction wires parallel, but by withdrawing the plunger at the rear of the model the act of convergence is effected, while the globes may also be swung from side to side in the manner of reading across the page.

Were it considered necessary, we might here refer to several well established facts among which we have experimental evidence that a very considerable number of dioptres of accommodation can be instigated without altering the convergence, that many dioptres of convergence can be produced without either increasing or decreasing the exhibited amount of accommodation.[1, 2] It has also been believed that the factor of convergence had a definite value in measuring distance of objects, but this can scarcely hold true from the fact that a considerable amount of prism may be introduced before the eyes, with bases either in or out, without in any appreciable degree deceiving us regarding distances.

There seems little doubt but that each individual muscle fibre is under direct control of its own particular nerve. Muscular fibres are

[1] J. H. Leventhal. Optical Journal & Review. Nov. 30, 1928., Feb. 8, 1929.
[2] F. McFadden, Amer. Journ. Optom. May, 1930.

fasciculated bound up in bundles, the combined effectivity of which is in proportion to the effort usually demanded. In like measure we find nerves grouped in bundles, sometimes contained within their own sheath, and at other times associated with other fasciculi.

But whether or not the Interni have ever been closely analyzed to determine whether two or even more muscular groups could be seggregated, there yet seems little information available; hence we are left to develop our knowledge upon the safe and reasonable experimental basis of trial and experience. We are very well aware that there are two essentially different, wholly unlike functions which are carried out by the interni. Vertical and horizontal rotations are many times greater in number than are convergent rotations, and therefore call for a different neuricity. We can certainly do no better than to consider such functions as originated from independent nuclear sources. Consistent thinking and understanding of these facts will assist us materially in the many problems connected with orthophorics.

Strabismic conditions, especially those of the high esophoric type, may not have any relationship whatever with that portion of the fibres of the Interni which govern the widest possible horizontal excursions. Exotropia may spring from lack of neuricity of that ganglion which governs the internus-convergens, or it may originate in low neuricity of the Internus-Rotor. Only a careful study of each case we treat can lead to the correct answer, and only upon such true appreciation of fact can we depend in successful treatment of orthophoric cases. It is strongly urged that optometrists study the possibilities of the duality of the internus, determine the factors of each, and conduct their orthoptic treatment work along these lines.

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A COMPARATIVE STUDY OF REFRACTION WITH AND WITHOUT A CYCLOPLEGIC*

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Review of Literature

The use of cycloplegics in refraction has been a subject of discussion by refractionists of various schools for many years. There have been arguments advanced favoring the use of cycloplegics as well as against their use. I have searched ophthalmic literature but failed to find any experimental evidence to prove the contention of that school of refractionists who insist that accurate refraction cannot be performed unless a cycloplegic be used. I found that some of the accepted so-called authorities pass up the subject by merely stating that a cycloplegic should be used in all cases, with the exception of people over 40 years of age. Others make no mention of it at all. De Schweinitz[1] has this to say on the subject: "In addition to the medicinal value of mydriatics in the treatment of diseases of the eye, *e. g.*, iritis, these drugs are employed as aids of an accurate determination of ametropia. With the ophthalmometer, with the aid of mydriatic, and with the methods of retinoscopy in the absence of prolonged mydriasis, good results are obtained; but, it is a safe rule in all cases of suitable age, and in the absence of contra-indicating symptoms, to employ a mydriatic before attempting to select correcting lenses. This remark applies particularly to cases of astigmatic errors. The mydriatic accomplishes three purposes:

"(a) It dilates the pupil, and permits a thorough exploration of the interior of the eye.

"(b) It paralyzes the actions of the ciliary muscle and places the accommodation in abeyance, rendering manifest types of ametropia which otherwise would remain latent.

"(c) It fulfills the important function of giving, during the time of its action, physiological rest to the eye that is under its influence and consequently helps to subdue any retinochoroidal disturbance or other congestive condition that pre-existing eyestrain may have originated."

---

*An abridgement of the material presented before the American Academy of Optometry at Chicago, December 19, 1932.

Ball[2] claims that, "Mydriatics are used for four purposes: (1) To dilate the pupil and thus permit the examination with the ophthalmoscope; (2) To paralyze the accommodation and thus permit the observer to measure the refraction by some methods which can be employed only when the ciliary muscle is made inactive; (3) To determine the diagnosis of 'eyestrain'; and (4) They are employed as therapeutic agents in inflammation, particularly those of the uveal tract."

Drs. Hansell and Sweet[3], discussing this subject, maintain that a cycloplegic *must* be used in order to determine the *latent* and *absolute* hyperopia. The final estimation is by the method of the test lenses and test cards. The lens that gives full visual acuity is the measure of the total hyperopia.

Dr. Edward Jackson, former editor of the American Journal of Ophthalmology and the leading exponent of the use of cycloplegics in refraction, maintains that no accurate refraction can be performed unless a cycloplegic be used. He stresses at the same time the importance of a post-cycloplegic refraction in order to make sure that the correcting glass chosen is really suited to the refraction of the eye when the pupil is contracted.

While the medical refractionists insist upon the use of cycloplegic in refraction, they are by no means unanimous upon the subject. There are some of the leading ophthalmologists in the United States as well as in foreign countries, who hold opposite views for various reasons as we shall presently show:

Dr. M. Tscherning[14], adjunct professor of the Laboratory of the Sorbonne, Paris, says in his standard work, Physiological Optics, "De Wecker held decided views on the abuse of atropine in ophthalmic practice and as far as its use for the determination of refraction is concerned I am in perfect agreement with him."

Dr. Ellice M. Alger[11], adjunct professor of the diseases of the eye in the New York Post Graduate Medical School and Hospital, etc., states that, "The physician who has fallen into the habit of always using a cycloplegic drug is utterly lost when it comes to the examination of an eye with the pupils small and the accommodation active, and thinks every one must be equally at sea."

Dr. Ernest Fuchs,[12] professor of ophthalmology in the University of Vienna, says in his book, Ophthalmology, which is generally accepted as the standard work on that subject, "Mydriatics on the contrary can excite an inflammatory attack in an eye that is predisposed to it (glaucoma) and not only the powerful mydriatic atropine, but also homatropine and cocaine."

There are some ophthalmologists who claim that when one understands accurately the technique of refraction he finds practically no need

for the use of cycloplegics. William H. Crisp, M. D., in a paper on the Value of a Post-cycloplegic Test, read before the American Ophthalmological Congress states that, "Often a *post-cycloplegic test is a poor substitute for a careful preliminary examination of the patient's refraction.* Perhaps the patient, especially if a child, comes in when the ophthalmic physician is very busy. The symptoms indicate a possible need for glasses, and a cycloplegic is ordered. After a cycloplegic examination there is some question as to how much of the correction the patient can be made to wear, and he is requested to return after the homatropine (or atropine) has had time to wear off. *I am almost tempted to say that the most important part of a refractive examination is the preliminary test. Even in the majority of children. This should be carried out and recorded with the utmost precision. With careful use of monolateral and bilateral fogging and astigmatic dial and the cross cylinder some workers would be surprised to find in how very large a proportion of their patients even in childhood they could come within a narrow margin of disclosing at the preliminary test all the error subsequently found under cycloplegia. Where such a close correspondence exists between the careful preliminary test and the examination under cycloplegia, there is obviously no great necessity for post-cycloplegic revision."*

While Post is a strong advocate of the use of cycloplegics in refraction, he at the same time shows that he does not think it very reliable when he states that he is almost tempted to say that the most important part of a refraction is the preliminary test, even in the majority of children, and while I do not agree with Post when he advocates the use of cycloplegics in refraction, I do agree with him when he stresses the importance of the preliminary test. As a matter of fact, I contend if an accurate preliminary test is once made, there is very little need for using a cycloplegic because it does not give any more accurate results than tests made without it, as we shall presently show.

The Conception of the Experiment

While I was connected with the eye department of one of the base hospitals during the World War, a heated controversy developed about the importance of using a cycloplegic in all cases that called for refraction. I contended that accurate refraction *can* be performed without a cycloplegic, while some of the officers in the eye department insisted that a cycloplegic *must* be used if accurate results are to be obtained.

To test the correctness of their views on the subject, I refracted a number of cases, performing a skiascopic and subjective test, first without using a cycloplegic and then the same tests were made using a cycloplegic, and the results compared. While this piece of research had its origin during the World War, the complete results have not been published before. I have continued to gather data on this subject and I shall now try to present for your consideration the material I have accumulated to date.

TABLE Ia

NON-CYCLOPLEGIC REFRACTION

Name	*Retinoscopy*	*Subjective*
C. A. 1	R. + 1.25 D. Sph. L. + 1.25 D. Cyl. Axis 65	R. + 1.00 D. Sph. L. + 1.00 D. Cyl. Axis 70
H. C. C. 2	R. + 0.25 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.75 D. Sph.	R. — 0.50 D. Cyl. Axis 90 L. + 0.50 D. Sph.
T. R. E. 3	R. — 0.50 D. Cyl. Axis 90 L. — 0.37 D. Cyl. Axis 90	R. — 0.50 D. Cyl. Axis 90 L. — 0.25 D. Cyl. Axis 90
T. E. 4	R. + 0.75 D. Sph. L. + 0.87 D. Sph.	R. + 0.25 D. Sph. L. + 0.87 D. Sph.
V. H. 5	R. + 6.00 D. Sph. L. + 5.50 D. Sph. ⊃ + 1.00 D. Cyl. Axis 90	R. + 5.00 D. Sph. L. + 4.00 D. Sph.
V. D. 6	R. + 4.25 D. Sph. L. + 4.50 D. Sph.	R. + 2.25 D. Sph. ⊃ + 0.25 D. Cyl. Axis 45 L. + 2.37 D. Sph. ⊃ + 0.37 D. Cyl. Axis 90
T. D. 7	R. + 0.75 D. Sph. ⊃ + 0.50 D. Cyl. Axis 180 L. + 0.75 D. Sph.	R. + 0.50 D. Sph. ⊃ + 0.50 D. Cyl. Axis 165 L. + 0.62 D. Sph.
T. S. 8	R. + 0.50 D. Sph. L. + 0.50 D. Sph.	R. + 0.25 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.50 D. Sph.
S. A. 9	R. + 0.75 D. Sph. L. + 0.50 D. Sph.	R. + 0.75 D. Sph. L. + 0.75 D. Sph.
R. G. F. 10	R. + 0.75 D. Cyl. Axis 80 L. + 0.50 D. Cyl. Axis 90	R. + 0.50 D. Cyl. Axis 90 L. + 0.50 D. Cyl. Axis 90

TABLE 1a

CYCLOPLEGIC REFRACTION

Retinoscopy	*Subjective*	*Name*
R. + 0.87 D. Sph. L. + 0.37 D. Sph. ⊃ + 1.00 D. Cyl. Axis 65	R. + 0.75 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.75 D. Cyl. Axis 60	C. A. 1
R. ..... L.	R. + 0.75 D. Sph. ⊃ — 0.50 D. Cyl. Axis 90 L. + 0.75 D. Sph.	H. H. C. 2
R. — 0.25 D. Cyl. Axis 90 L. — 0.25 D. Cyl. Axis 90	R. — 0.25 D. Cyl. Axis 90 L. — 0.25 D. Cyl. Axis 90	T. R. E. 3
R. + 0.75 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.75 D. Sph.	R. + 0.25 D. Sph. L. + 0.25 D. Sph.	T. E. 4
R. + 6.00 D. Sph. L. + 5.50 D. Sph. ⊃ + 1.00 D. Cyl. Axis 90	R. + 5.00 D. Sph. L. + 4.00 D. Sph. ⊃ + 1.00 D. Cyl. Axis 90	V. H. 5
R. + 5.25 D. Sph. L. + 5.00 D. Sph.	R. + 5.00 D. Sph. ⊃ + 0.25 D. Cyl. Axis 60 L. + 4.50 D. Sph. ⊃ + 0.37 D. Cyl. Axis 90	V. D. 6
R. + 0.75 D. Sph. ⊃ + 0.50 D. Cyl. Axis 180 L. + 1.00 D. Sph.	R. + 0.62 D. Sph. ⊃ + 0.50 D. Cyl. Axis 180 L. + 1.00 D. Sph.	T. D. 7
R. + 0.50 D. Sph. L. + 0.50 D. Sph.	R. + 0.25 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.25 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90	T. S. 8
R. + 0.75 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.75 D. Sph.	R. + 1.00 D. Sph. L. + 1.00 D. Sph.	S. A. 9
R. + 0.25 D. Sph. ⊃ + 0.50 D. Cyl. Axis 90 L. + 0.25 D. Sph. ⊃ + 0.50 D. Cyl. Axis 90	R. + 0.50 D. Cyl. Axis 90 L. + 0.50 D. Cyl. Axis 90	R. G. F. 10

TABLE 1a (continued)

NON-CYCLOPLEGIC REFRACTION

Name		Retinoscopy	Subjective
S. R. L.	R.	.....	R. + 0.75 D. Sph.
11	L.	.....	L. + 0.50 D. Sph.
R. C. J.	R.	+ 0.62 D. Sph.	R. + 0.50 D. Sph.
12	L.	+ 0.75 D. Sph.	L. + 0.62 D. Sph.
S. L. H.	R.	— 0.50 D. Sph.	R. — 0.50 D. Sph.
13	L.	— 0.50 D. Sph.	L. — 0.50 D. Sph.
P. A. E.	R.	+ 1.50 D. Sph.	R. + 1.37 D. Sph.
14	L.	+ 1.37 D. Sph.	L. + 1.00 D. Sph.
A. F.	R.	+ 0.75 D. Sph.	R. + 0.75 D. Sph.
15	L.	+ 0.75 D. Sph.	L. + 0.75 D. Sph.
M. J.	R.	+ 0.62 D. Cyl. Axis 65	R. + 0.25 D. Sph. ⊃ + 0.50 D. Cyl. Axis 60
16	L.	+ 0.50 D. Cyl. Axis 95	L. + 0.50 D. Sph. ⊃ + 0.50 D. Cyl. Axis 95
M. H. M.	R.	.....	R. + 0.75 D. Sph.
17	L.	.....	L. + 0.75 D. Sph.
L. A.	R.	+ 0.75 D. Sph.	R. + 0.50 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90
18	L.	+ 1.25 D. Sph.	L. + 0.75 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90
J. L.	R.	+ 1.25 D. Sph.	R. none (amblyopic)
19	L.	+ 1.00 D. Sph.	L. + 0.75 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90
J. C. A.	R.	+ 2.00 D. Sph.	R. + 1.00 D. Sph.
20	L.	+ 1.50 D. Sph.	L. + 0.75 D. Sph.

TABLE 1a (continued)

CYCLOPLEGIC REFRACTION

Retinoscopy	*Subjective*	*Name*
R.	R. + 1.00 D. Sph.	S. L. R.
L.	L. + 0.75 D. Sph.	11
R. + 1.25 D. Sph.	R. + 0.50 D. Sph.	R. C. J.
L. + 1.00 D. Sph.	L. + 0.50 D. Sph.	12
R. + 0.50 D. Sph.	R. — 0.50 D. Sph.	S. L. H.
L. + 0.50 D. Sph.	L. — 0.37 D. Sph.	13
R. + 2.00 D. Sph.	R. + 1.25 D. Sph.	P. A. E.
L. + 1.50 D. Sph.	L. + 1.00 D. Sph.	14
R. + 1.12 D. Sph.	R. + 1.25 D. Sph.	A. F.
L. + 1.12 D. Sph.	L. + 1.25 D. Sph.	15
R. + 0.37 D. Sph. ⊃ + 0.75 D. Cyl. Axis 60	R. + 0.75 D. Sph. ⊃ + 0.62 D. Cyl. Axis 75	M. J.
L. + 0.37 D. Sph. ⊃ + 0.50 D. Cyl. Axis 100	L. + 0.75 D. Sph. ⊃ + 0.50 D. Cyl. Axis 90	16
R.	R. + 1.00 D. Sph.	M. H. M.
L.	L. + 1.00 D. Sph.	17
R. + 0.75 D. Sph.	R. + 0.25 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90	L. A.
L. + 1.25 D. Sph.	L. + 0.75 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90	18
R. + 2.00 D. Sph.	R. none (amblyopic)	J. L.
L. + 1.25 D. Sph.	L. + 1.00 D. Sph.	19
R. + 1.00 D. Sph.	R. + 0.50 D. Sph.	J. C. A.
L. + 0.75 D. Sph.	L. + 0.25 D. Sph.	20

TABLE 1a (continued)

NON-CYCLOPLEGIC REFRACTION

Name	*Retinoscopy*	*Subjective*
H. J. L. 21	R. + 0.75 D. Sph. L. + 0.75 D. Sph.	R. + 0.50 D. Sph. L. + 0.37 D. Sph.
H. N. 22	R. + 3.50 D. Cyl. Axis 100 L. + 4.00 D. Cyl. Axis 75	R. — 0.50 D. Sph. ⊃ + 3.50 D. Cyl. Axis 105 L. + 3.50 D. Cyl. Axis 75
G. L. 23	R. + 0.50 D. Sph. ⊃ + 0.12 D. Cyl. Axis 90 L. + 0.25 D. Sph.	R. + 0.25 D. Sph. ⊃ + 0.12 D. Cyl. Axis 90 L. + 0.25 D. Sph.
G. P. A. 24	R. + 0.87 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.87 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90	R. + 0.87 D. Sph. L + 0.87 D. Sph.
G. M. C. 25	R. ..... L.	R. — 1.00 D. Sph. L. — 1.00 D. Sph.
F. E. F. 26	R. + 1.25 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.75 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90	R. + 0.50 D. Sph. L. + 0.50 D. Sph.
D. E. 27	R. — 3.00 D. Cyl. Axis 15 L. — 4.00 D. Cyl. Axis 165	R. — 3.00 D. Cyl. Axis 15 L. — 3.50 D. Cyl. Axis 165
F. P. 28	R. + 1.00 D. Cyl. Axis 90 L. + 0.62 D. Cyl. Axis 90	R. ..... L. .....
C. B. 29	R. + 0.75 D. Cyl. Axis 80 L. + 0.75 D. Cyl. Axis 90	R. + 0.25 D. Sph. ⊃ + 0.50 D. Cyl. Axis 90 L. + 0.25 D. Sph. ⊃ + 0.50 D. Cyl. Axis 90
C. M. 30	R. + 0.75 D. Sph. L. + 0.75 D. Sph.	R. + 0.50 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.50 D. Sph.

TABLE 1a (continued)
CYCLOPLEGIC REFRACTION

Retinoscopy	*Subjective*	*Name*
R. + 0.75 D. Sph. L. + 0.50 D. Sph.	R. + 0.62 D. Sph. L. + 0.37 D. Sph.	H. J. L. 21
R. + 1.00 D. Sph. ⊃ + 4.00 D. Cyl. Axis 100 L. + 1.50 D. Sph. ⊃ + 4.00 D. Cyl. Axis 75	R. — 0.50 D. Sph. + 4.00 D. Cyl. Axis 100 L. + 4.00 D. Cyl. Axis 75	H. N. 22
R. + 0.37 D. Sph. L. + 0.37 D. Sph.	R. + 0.37 D. Sph. L. + 0.37 D. Sph.	G. L. 23
R. + 0.87 D. Sph. L. + 0.87 D. Sph.	R. + 0.62 D. Sph. L. + 0.62 D. Sph.	G. P. A. 24
R. ..... L.	R. — 1.00 D. Sph. L. — 1.00 D. Sph.	G. M. C. 25
R. Neutral L. Neutral	R. + 0.50 D. Sph. L. + 0.50 D. Sph.	F. E. F. 26
R. + 0.75 D. Sph. ⊃ — 3.00 D. Cyl. Axis 15 L. + 0.50 D. Sph. ⊃ — 4.00 D. Cyl. Axis 180	R. + 0.75 ⊃ — 2.75 D. Cyl. Axis 15 L. — 3.75 D. Cyl. Axis 165	D. E. 27
R. + 1.00 D. Cyl. Axis 90 L. + 0.50 D. Cyl. Axis 90	R. ..... L.	F. P. 28
R. + 0.25 D. Sph. ⊃ + 0.50 D. Cyl. Axis 90 L. + 0.37 D. Sph. ⊃ + 0.37 D. Cyl. Axis 90	R. + 0.50 ⊃ + 0.50 D. Cyl. Axis 90 L. + 0.50 ⊃ + 0.37 D. Cyl. Axis 90	C. B. 29
R. + 0.50 D. Sph. ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.25 D. Sph.	R. + 0.50 ⊃ + 0.25 D. Cyl. Axis 90 L. + 0.25 ⊃ + 0.25 D. Cyl. Axis 90	C. M. 30

The Problem

The problem we set out to solve is this:

(1) Are the refractive results more accurate when a cycloplegic is used than when none is used?

(2) If there be a difference in the findings, where does that difference show up, most in the skiascopic or subjective results?

(3) Is the difference greater in the spherical or cyclindrical findings?

(4) How do the non-cyloplegic skiascopic findings agree with those of the cycloplegic?

(5) How do the non-cycloplegic subjective findings agree with those of the cycloplegic?

The material used consists of a number of service men who called for refraction at the eye department. The group is made up of healthy young men. The ages are from 18 years and over. Sixty-five subjects were used in this experiment. The cycloplegic used was a mixture of 2% homatropine and 2% cocaine. Two drops were instilled every ten minutes for one hour or more until there was complete cycloplegia.

The evidence which we are here to present is along four different lines:

(1) The cases which I personally refracted both with and without a cycloplegic.

(2) Clinical cases I studied in my own office, as well as those of other refractionists.

(3) Conclusions on this subject arrived at by some medical refractionists.

(4) Psychological evidence.

In order that you may be able to comprehend and get a clear picture of how the different findings compared with each other and how the figures in the following tables (1 to 20, inclusive) were arrived at, I am tabulating here the skiascopic and subjective findings obtained when refracting the subject, first without the use of a cycloplegic, and the results of the same tests performed after a cycloplegic had been properly instilled. We are only listing here the results of a few cases, just enough to enable you to get a bird's-eye view as to how the various findings compare when placed side by side, as given in Table Ia (p. 76).

TABLE 1.

Cases where the non-cycloplegic skiascopy was found to be the *same* as the cycloplegic skiascopy.

+ 25 spherical to + 1.00 spherical	24 eyes
+ 1.25 spherical to + 2.00 spherical	2 eyes
+ 2.25 spherical to + 4.00 spherical	3 eyes
+ 4.00 spherical to + 6.00 spherical	3 eyes
Total	32 eyes

TABLE 2.

Cases where the cycloplegic skiascopy was *greater* than the non-cycloplegic skiascopy.

Cycloplegic skiascopy:		
+ 25 D.	spherical greater	8 eyes
+ 50 D.	" "	8 eyes
+ 75 to + 1.00 D.	" "	8 eyes
+ 1.25 to + 2.00 D.	" "	4 eyes
+ 2.25 to + 4.00 D.	" "	3 eyes
+ 4.25 to + 6.00 D.	" "	1 eye
Total		32 eyes

TABLE 3.

Cases where the non-cycloplegic skiascopy was *greater* than cycloplegic skiascopy.

Non-cycloplegic skiascopy:		
+ 25 D. Sphere	greater	12 eyes
+ 50 D. Sphere	"	3 eyes
+ 75 to + 1.00 D. Sphere	"	1 eye
+ 1.25 to + 2.00 D. Sphere	"	0 eyes
+ 2.25 to + 4.00 D. Sphere	"	0 eyes
+ 4.25 to + 6.00 D. Sphere	"	0 eyes
Total		16 eyes

TABLE 4.

Cases where subjective findings under cycloplegic are the *same* as non-cycloplegic subjectives.

+ 25 to + 1.00 D spherical cycloplegic subjective same as non-cycloplegic subjective	34 eyes
+ 1.25 to + 2.00 D. spherical cycloplegic subjective same as non-cycloplegic subjective	2 eyes
+ 2.25 to + 4.00 D. spherical cycloplegic subjective same as non-cycloplegic subjective	2 eyes
+ 4.25 to + 6.00 D. spherical cycloplegic subjective same as non-cycloplegic subjective	1 eye
Total	39 eyes

TABLE 5.

Cases where cycloplegic subjective findings are *greater* than non-cycloplegic subjective findings.

Cycloplegic subjective + 25 D. sphere greater than non-cycloplegic subjective	17 eyes
Cycloplegic subjective + 50 D. sphere greater than non-cycloplegic subjective	8 eyes
Cycloplegic subjective + 75 to + 1.00 D. Sphere greater than non-cycloplegic subjective	7 eyes
Cycloplegic subjective + 1.25 to + 2.00 D. Sphere greater than non-cycloplegic subjective	2 eyes

Cycloplegic subjective + 2.25 to + 4.00 D. Sphere greater than non-cycloplegic subjective	6 eyes
Cycloplegic subjective + 4.25 to + 6.00 D. Sphere greater than non-cycloplegic subjective	0 eyes
Total	40 eyes

TABLE 6.

Cases where non-cycloplegic subjective findings are *greater* than cycloplegic subjective findings.

Non-cycloplegic subjective + 25 D. spherical greater than cycloplegic subjective	7 eyes
Non-cycloplegic subjective + 50 D. spherical greater than cycloplegic subjective	0 eyes
Non-cycloplegic subjective + 75 to + 1.00 D. spherical greater than cycloplegic subjective	0 eyes
Non-cycloplegic subjective + 1.25 to + 2.00 D. spherical greater than cycloplegic subjective	0 eyes
Non-cycloplegic subjective + 2.25 to + 4.00 D. spherical greater than cycloplegic subjective	0 eyes
Non-cycloplegic subjective + 4.25 to + 6.00 D. spherical greater than cycloplegic subjective	0 eyes
Total	7 eyes

TABLE 7.

Cases where the skiascopic and subjective findings are the *same* under cycloplegic.

+ 25 to + 1.00 D. spherical cycloplegic skiascopy same as cycloplegic subjective	19 eyes
+ 1.25 to + 2.00 D. spherical cycloplegic skiascopy same as cycloplegic subjective	2 eyes
+ 2.25 to + 4.00 D. spherical cycloplegic skiascopy same as cycloplegic subjective	3 eyes
+ 4.25 to + 6.00 D. spherical cycloplegic skiascopy same as cycloplegic subjective	0 eyes
Total	24 eyes

TABLE 8.

Cases where cycloplegic skiascopic findings are *greater* than the cycloplegic subjective.

Cycloplegic skiascopy + 25 to + 1.00 D. Sphere greater cycloplegic subjective	43 eyes
Cycloplegic skiascopy + 1.25 to + 2.00 D. Sphere greater cycloplegic subjective	3 eyes
Cycloplegic skiascopy + 2.25 to + 4.00 D. Sphere greater cycloplegic subjective	1 eye
Cycloplegic skiascopy + 4.25 to + 6.00 D. Sphere greater cycloplegic subjective	0 eyes
Total	47 eyes

TABLE 9.

Cases where the findings of the non-cycloplegic skiascopy are the *same as* non-cycloplegic subjective.

+ 25 to + 1.00 D. spherical. Non-cycloplegic skiascopy same as non-cycloplegic subjective	28 eyes
+ 1.25 to + 2.00 D. spherical. Non-cycloplegic skiascopy same as non-cycloplegic subjective	2 eyes
+ 2.25 to + 4.00 D. spherical. Non-cycloplegic skiascopy same as non-cycloplegic subjective	0 eyes
+ 4.25 to + 6.00 D. spherical. Non-cycloplegic skiascopy same as non-cycloplegic subjective	0 eyes
Total	30 eyes

TABLE 10.

Cases where non-cycloplegic skiascopy findings are *greater* than the non-cycloplegic subjective findings.

Non-cycloplegic skiascopy + 25 to + 1.00 D. Spherical greater than non-cycloplegic subjective	34 eyes
Non-cycloplegic skiascopy + 1.25 to + 2.00 D. Spherical greater than non-cycloplegic subjective	10 eyes
Non-cycloplegic skiascopy + 2.25 to + 4.00 D. Spherical greater than non-cycloplegic subjective	2 eyes
Non-cycloplegic skiascopy + 4.25 to + 6.00 D. Spherical greater than non-cycloplegic subjective	0 eyes
Total	46 eyes

TABLE 11.

Cases where the skiascopic astigmatic findings were the *same* under cycloplegic and non-cycloplegic.

+ 25 to + 1.00 D. Cylinder same in cycloplegic and non-cycloplegic skiascopy	23 eyes
+ 1.25 to + 2.00 D. Cylinder same in cycloplegic and non-cycloplegic skiascopy	0 eyes
+ 2.25 to + 4.00 D. Cylinder same in cycloplegic and non-cycloplegic skiascopy	1 eye
+ 4.25 to + 6.00 D. Cylinder same in cycloplegic and non-cycloplegic skiascopy	0 eyes
Total	24 eyes

TABLE 12.

Cases where astigmatic findings were *greater* under cycloplegic skiascopy than non-cycloplegic.

+ 25 D. Cylinder greater than in non-cycloplegic skiascopy	10 eyes
+ 50 D. Cylinder greater than in non-cycloplegic skiascopy	3 eyes
+ 75 to + 1.00 D. Cylinder greater than in non-cycloplegic skiascopy	4 eyes
+ 1.25 to + 2.00 D. Cylinder greater than in non-cycloplegic skiascopy	0 eyes

+ 2.25 to + 4.00 D. Cylinder greater than in non-cycloplegic skiascopy	0 eyes
+ 4.25 to + 6.00 D. Cylinder greater than in non-cycloplegic skiascopy	0 eyes
Total	17 eyes

TABLE 13.

Cases where astigmatic findings were *greater* under non-cycloplegic skiascopy than cycloplegic.

+ 25 D. Cylinder greater than under cycloplegic skiascopy	5 eyes
+ 50 D. Cylinder greater than under cycloplegic skiascopy	5 eyes
+ 75 to + 1.00 D. Cylinder greater than under cycloplegic skiascopy	6 eyes
+ 1.25 to + 2.00 D. Cylinder greater than under cycloplegic skiascopy	1 eye
+ 2.25 to + 4.00 D. Cylinder greater than under cycloplegic skiascopy	0 eyes
+ 4.25 to + 6.00 D. Cylinder greater than under cycloplegic skiascopy	0 eyes
Total	17 eyes

TABLE 14.

Cases where astigmatic findings were the *same* under cycloplegic and non-cycloplegic subjective tests.

+ 25 to + 1.00 D. Cylinder cycloplegic and non-cycloplegic subjective findings are same	37 eyes
+ 1.25 to + 2.00 D. Cylinder cycloplegic and non-cycloplegic subjective findings are same	1 eye
+ 2.25 to + 4.00 D. Cylinder cycloplegic and non-cycloplegic subjective findings are same	0 eyes
+ 4.25 to + 6.00 D. Cylinder cycloplegic and non-cycloplegic subjective findings are same	0 eyes
Total	38 eyes

TABLE 15.

Cases where the astigmatic cycloplegic subjective findings were *greater* than the non-cycloplegic subjective findings.

Cycloplegic subjective + 25 D. Cylinder greater than non-cycloplegic subjective	5 eyes
Cycloplegic subjective + 50 D. Cylinder greater than non-cycloplegic subjective	3 eyes
Cycloplegic subjective + 75 to + 1.00 D. Cylinder greater than non-cycloplegic subjective	2 eyes
Cycloplegic subjective + 1.25 to + 2.00 D. Cylinder greater than non-cycloplegic subjective	0 eyes
Cycloplegic subjective + 2.25 to + 4.00 D. Cylinder greater than non-cycloplegic subjective	0 eyes

Cycloplegic subjective + 4.25 to + 6.00 D. Cylinder greater than non-cycloplegic subjective	0 eyes
Total	10 eyes

TABLE 16.

Cases where non-cycloplegic subjective astigmatic findings are *greater* than cycloplegic subjective.

Non-cycloplegic subjective + 25 D. Cylinder greater than cycloplegic subjective	9 eyes
Non-cycloplegic subjective + 50 D. Cylinder greater than cycloplegic subjective	1 eye
Non-cycloplegic subjective + 75 to + 1.00 D. Cylinder greater than cycloplegic subjective	2 eyes
Non-cycloplegic subjective + 1.25 to + 2.00 D. Cylinder greater than cycloplegic subjective	0 eyes
Non-cycloplegic subjective + 2.25 to + 4.00 D. Cylinder greater than cycloplegic subjective	0 eyes
Non-cycloplegic subjective + 4.25 to + 6.00 D. Cylinder greater than cycloplegic subjective	0 eyes
Total	12 eyes

TABLE 17.

Cases where the astigmatic skiascopic and subjective findings are the *same* under a cycloplegic examination.

Cycloplegic Skiascopy + 25 D. Cylinder same as cycloplegic subjective	5 eyes
Cycloplegic Skiascopy + 50 D. Cylinder same as cycloplegic subjective	13 eyes
Cycloplegic Skiascopy + 75 to + 1.00 D. Cylinder same as cycloplegic subjective	3 eyes
Cycloplegic Skiascopy + 1.25 to + 2.00 D. Cylinder same as cycloplegic subjective	2 eyes
Cycloplegic Skiascopy + 2.25 to + 4.00 D. Cylinder same as cycloplegic subjective	2 eyes
Cycloplegic Skiascopy + 4.25 to + 6.00 D. Cylinder same as cycloplegic subjective	0 eyes
Total	25 eyes

TABLE 18.

Cases where astigmatic cycloplegic skiascopic findings are *greater* than cycloplegic subjective findings.

Cycloplegic Skiascopy + 25 D. Cylinder greater cycloplegic subjective	12 eyes
Cycloplegic Skiascopy + 50 D. Cylinder greater cycloplegic subjective	6 eyes
Cycloplegic Skiascopy + 75 to + 1.00 D. Cylinder greater cycloplegic subjective	4 eyes

Cycloplegic Skiascopy + 1.25 to + 2.00 D. Cylinder greater cycloplegic subjective	0 eyes
Cycloplegic Skiascopy + 2.25 to + 4.00 D. Cylinder greater cycloplegic subjective	0 eyes
Cycloplegic Skiascopy + 4.25 to + 6.00 D. Cylinder greater cycloplegic subjective	0 eyes
Total	22 eyes

TABLE 19.

Cases where the astigmatic skiascopic and subjective findings are the *same* under a non-cycloplegic examination.

Non-cycloplegic Skiascopy + 25 D. Cylinder same as non-cycloplegic subjective	8 eyes
Non-cycloplegic Skiascopy + 50 D. Cylinder same as non-cycloplegic subjective	11 eyes
Non-cycloplegic Skiascopy + 75 to + 1.00 D. Cylinder same as non-cycloplegic subjective	2 eyes
Non-cycloplegic Skiascopy + 1.25 to + 2.00 D. Cylinder same as non-cycloplegic subjective	0 eyes
Non-cycloplegic Skiascopy + 2.25 to + 4.00 D. Cylinder same as non-cycloplegic subjective	0 eyes
Non-cycloplegic Skiascopy + 4.25 to + 6.00 D. Cylinder same as non-cycloplegic subjective	0 eyes
Total	21 eyes

TABLE 20.

Cases where astigmatic skiascopic findings are *greater* than subjective findings under a non-cycloplegic examination.

Non-cycloplegic Skiascopy + 25 D. Cylinder greater than non-cycloplegic subjective	11 eyes
Non-cycloplegic Skiascopy + 50 D. Cylinder greater than non-cycloplegic subjective	3 eyes
Non-cycloplegic Skiascopy + 75 to + 1.00 D. Cylinder greater than non-cycloplegic subjective	2 eyes
Non-cycloplegic Skiascopy + 1.25 to + 2.00 D. Cylinder greater than non-cycloplegic subjective	0 eyes
Non-cycloplegic Skiascopy + 2.25 to + 4.00 D. Cylinder greater than non-cycloplegic subjective	0 eyes
Non-cycloplegic Skiascopy + 4.25 to + 6.00 D. Cylinder greater than non-cycloplegic subjective	0 eyes
Total	16 eyes

1. *Cases I personally refracted both with and without the use of a cycloplegic.* (Sixty-five subjects were used in this experiment.)

Results

Of the 130 single eyes refracted the results given in the preceding tables were found. (See tables 1, 2 and 3.) A study of tables 1 and 2 will show that the number of eyes where the cycloplegic skia-

scopic and non-cycloplegic findings were the same, is exactly equal to the number where there was some difference between the non-cycloplegic and cycloplegic skiascopic findings. If we should transfer the first group of table 2 where the difference in the findings of eight eyes is only a + 25 D. Sph. which is within the limit of error and therefore we would be justified in considering these under table 1 where the findings in each case are equal, we would then have 40 eyes where the spherical findings under non-cycloplegic and cycloplegic skiascopy are the same as against 24 eyes where the cycloplegic findings were greater than the non-cycloplegic.

A study of tables 2 and 3 will show that there were just half as many cases where the non-cycloplegic skiascopic findings were greater than the cycloplegic findings, when compared with those of table 2 where the cycloplegic findings were greater.

A study of tables 4 and 5 will show that the number of cases where the cycloplegic subjective findings are the same as the non-cycloplegic subjective, is nearly equal to number of cases where the findings differed. There are 39 in table 4 and 40 in table 5, if we should transfer the first group of table 5 where the difference of 17 cases is only + 25 D. Sphere, which is within the limit of error and therefore we would be justified in considering these under table 4, where the findings in each case are the same, because the patient's judgment, it has been found by the writer, is not reliable on such small amount. We would then have 56 cases where the findings are the *same* under either test as against 23 cases where there was some difference.

A study of tables 7 and 9 will show that the non-cycloplegic skiascopic and subjective findings are the same in a greater number of cases than the skiascopic and subjective findings under a cycloplegic. Also tables 8 and 10 show that there are just as many cases where the skiascopic and subjective spherical findings vary under a cycloplegic as compared with those obtained under a non-cycloplegic.

A study of table 11 will reveal that the number of eyes where the cycloplegic and non-cycloplegic astigmatic findings were the same is about one and one-half times as those in table number 12, where the cycloplegic astigmatic findings are greater than the non-cycloplegic findings.

A study of tables 12 and 13 will reveal that the number of cases where the non-cycloplegic astigmatic findings were greater than the cycloplegic is exactly equal to the number where the cycloplegic findings were greater than the non-cycloplegic astigmatic findings, namely, there were 17 in each group or thirteen per cent.

An analysis of tables 14 and 15 shows that there were nearly four times as many cases where the findings were the same in the non-cycloplegic and cycloplegic subjective tests as compared with those of table 15 where there was some difference in the findings under the two tests. There are 38 eyes or 29.7% in table 14, and only 10 or 7.7% in table 15. The same is nearly true when a comparison is made between tables 14 and 16.

SUMMARY OF RESULTS OF TOTALS IN TABLES 1 TO 20, INCLUSIVE.

THE TOTALS ARE HERE GIVEN IN PERCENTAGE FORM.

TABLE 21.

Table Number		Per Cent of Number of Eyes
	Spherical Skiascopic Findings.	
1.	Non-cycloplegic and Cycloplegic are the same	24.6%
2.	Cycloplegic greater than Non-cycloplegic	24.6%
3.	Non-cycloplegic greater than Cycloplegic	12.3%
	Spherical Skiascopic Findings.	
4.	Non-cycloplegic and Cycloplegic are the same	30. %
5.	Cycloplegic greater than Non-cycloplegic	30.1%
6.	Non-cycloplegic greater than Cycloplegic	5.4%
	Spherical Findings.	
7.	Cycloplegic Skiascopy and Subjective are the same	18.5%
8.	Cycloplegic Skiascopy greater than Subjective	36.1%
9.	Non-cycloplegic Skiascopy same as Non-cycloplegic subjective	23. %
10.	Non-cycloplegic Skiascopy greater than Non-cycloplegic Subjective	35.5%
	Astigmatic Skiascopic Findings.	
11.	Non-cycloplegic and Cycloplegic are the same	18.5%
12.	Cycloplegic greater than Non-cycloplegic	13. %
13.	Non-cycloplegic greater than Cycloplegic	13. %
	Astigmatic Subjective Findings.	
14.	Non-cycloplegic and Cycloplegic are the same	29.7%
15.	Cycloplegic greater than Non-cycloplegic	7.7%
16.	Non-cycloplegic greater than Cycloplegic	9.2%
	Astigmatic Findings.	
17.	Cycloplegic Skiascopy and Subjective are the same	19.2%
18.	Cycloplegic Skiascopy greater than Subjective	17. %
19.	Non-cycloplegic Skiascopy and Subjective are the same	16.1%
20.	Non-cycloplegic Skiascopy greater than Subjective	12.3%

EXPLANATION ABOUT FIGURE 1 ON PAGE 266.

In figure 1 the numbers along the abscissa represent the percentage of the number of eyes. The numbers 1 to 20 along the ordinate correspond to the numbers 1 to 20, inclusive, as found to the left in table 21, which is a summary of the results. The results as given in this table are plotted in the accompanying figure. That is, number 1 along the ordinate represents the percentage of eyes in which the non-cycloplegic and cycloplegic spherical skiascopic findings are the same, the amount of which is 24.6%. Number 2 along the ordinate represents the percentage of eyes in which the cycloplegic spherical skiascopic findings are greater than the non-cycloplegic. This also amounts to 24.6%, etc. In other words, the table number 21 besides being a summary of the results serves also as the legend to figure 1.

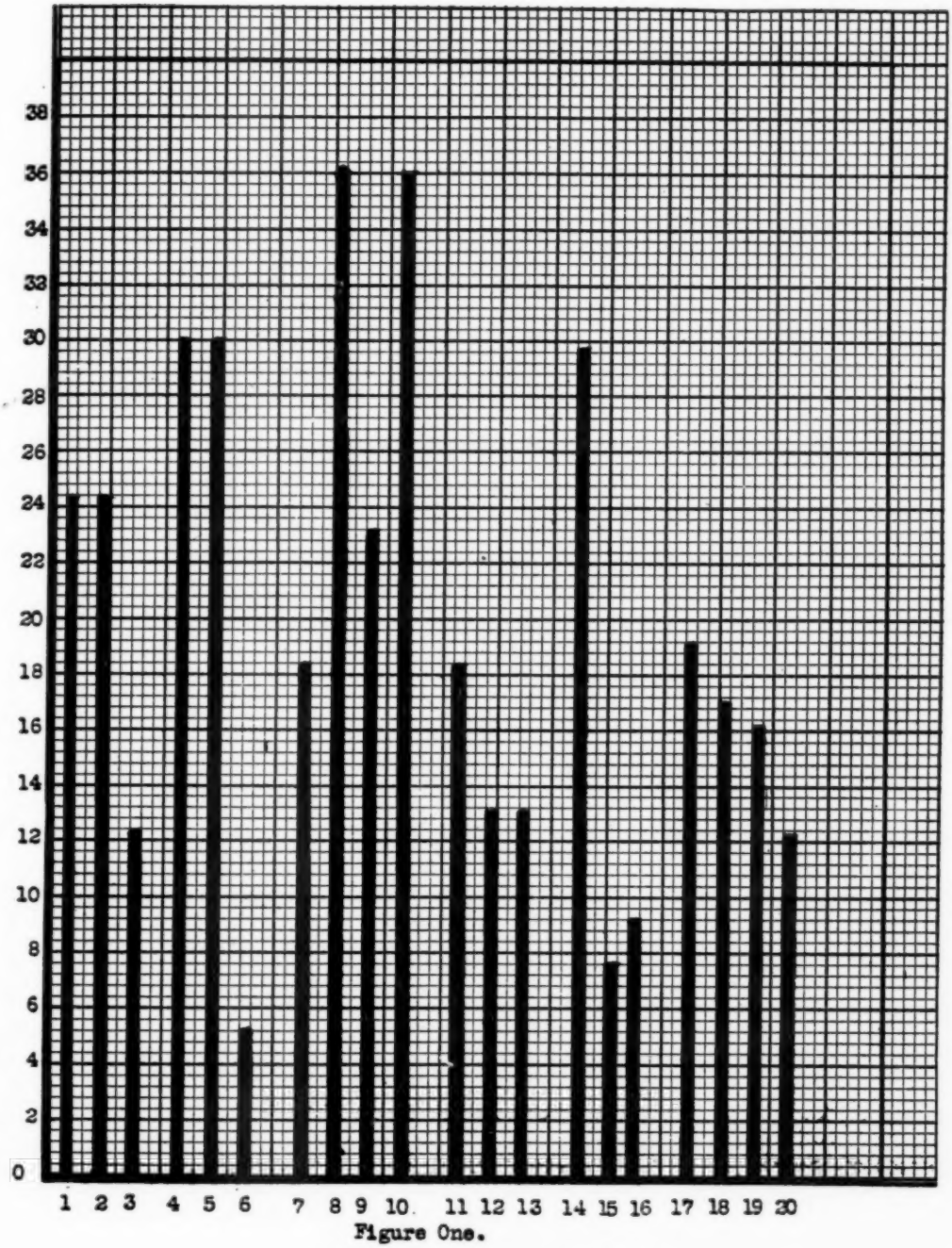

Figure One.

(Refer to footnote on page 265.)

Tables 17 and 18 show that the number of cases where the cylindrical findings are the *same* under cycloplegic skiascopy and cycloplegic subjective is greater than the number of cases were the findings under the two tests differ. The same condition is also revealed from a study of tables 19 and 20. Also by comparing tables 18 and 20 it is found that the number of cases where there is a difference between the skiascopic and subjective findings is greater under the cycloplegic than the non-cycloplegic examination.

Summary of Results.

In order to get a clearer view of the results obtained in the tables 1 to 20, inclusive, the totals of these tables are here converted into percentage form. This will enable us to make the comparisons of the findings more easily. The numbers 1 to 20, inclusive, to the left in table 21, correspond to the table numbers 1 to 20, from whose totals these percentages were derived.

It is interesting to compare the skiascopic findings in tables number 1 and 2. In No. 1 the non-cycloplegic and cycloplegic findings agree in 24.6% and disagree in 24.6% as is indicated in number 2.

The subjective findings in number 4, the non-cycloplegic and cycloplegic findings agree in 30% and the cycloplegic subjective is greater than the non-cycloplegic in 30%.

Of special interest is the comparison between the tables 7 and 8. In 7 we find that the cycloplegic skiascopy and subjective agree in only 18%, and disagree in 36%. That is for each case where there is agreement between the skiascopic and subjective findings under a cycloplegic, there are two cases where there is a disagreement between these two tests.

Another point of interest is the comparison between 8 and 10. In 8 the cycloplegic skiascopy is greater than the subjective in 36%. In number 10 we find that the non-cycloplegic skiascopy is greater than the subjective in a nearly equal amount, namely 35.5%.

In table 21, numbers 1 to 10, inclusive, give the agreements and disagreements between the spherical findings under both types of examinations and numbers 11 to 20, inclusive, give the agreements and disagreements between the astigmatic findings.

Number 11 indicates that there is agreement in 18.5% between the non-cycloplegic and cycloplegic skiascopy, while in number 13 we find that the non-cycloplegic skiascopy is greater than the cycloplegic in 13%. Comparing tables 12 and 13 we find in 12 that the cycloplegic skiascopy is greater than the non-cycloplegic in 13% while in table number 13 we find the reverse condition to hold true in an equal number of cases, namely 13%.

We find another striking point of interest when we compare numbers 14, 15 and 16. In 14 we find that the non-cycloplegic and cycloplegic astigmatic subjective findings agree in 29.7%. In number 15 we find that the cycloplegic subjective is greater than the non-cycloplegic in

7.7%; that is, there are more than four times as many agreements in number 14 as there are disagreements in number 15. And if we compare 14 with 16 we find that there are more than three times as many agreements in 14 than the disagreements in 16.

Comparing number 4 and 14 we find in 4 that the non-cycloplegic and cycloplegic spherical subjective findings agree in 30% of the cases and in 14 we find that the subjective astigmatic findings under similar types of examination also agree in about the same number of cases, namely 29.7%.

When we compare numbers 17 and 18 we find that the cycloplegic skiascopic and subjective findings agree in 19.2% and the cycloplegic skiascopic findings are greater in 17%.

Comparing 19 and 18 we find that non-cycloplegic skiascopy and subjective findings agree in 16.1% and cycloplegic skiascopy is greater than the subjective in 17%.

From the comparative study of the percentages of agreements and disagreements between the findings obtained under each system of refraction, one can not help but draw these conclusions: (a) That a cycloplegic in refraction does not help to obtain more accurate results. (b) In most cases a cycloplegic is a hindrance to accurate refraction.

The value of the use of cycloplegic in refraction work can further be shown by a study of some cases from my own practice which were refracted formerly by others under a cycloplegic and later I refracted them without the use of a cycloplegic and the results obtained prove the contention that a cycloplegic is not at all necessary and in many cases not desirable.

2. *Conclusions on this subject arrived at by some medical refractionists.*

There are a number of leading ophthalmologists who found clinically that not all cases in which a cycloplegic was used were refracted correctly. For instance, Theobold[4] in his discussion of Subnormal Accommodative Power, before the American Ophthalmological Society in 1894, reports that in a number of cases he examined using a cycloplegic, he found that the patients were wearing the wrong correction although they were formerly refracted under a cycloplegic by reputable ophthalmologists.

A. S. Morton,[6] surgeon to Royal London Ophthalmic Hospital, claims that "when used in cases of active accommodation homatropine sometimes appears to render the accommodative effort spasmodic and uncontrollable so that the results are quite untrustworthy." Pascal[13] holds similar views. He claims that the flabbiness of the crystalline lens and ciliary muscle produced by the drug may show less intrinsic refractive power and therefore more hyperopia than is actually present, even including the latent error. At times the muscle may not respond fully to the effect of the drug. In that case only a small amount of the error will be revealed.

Dr. T. Harrison Buttler[15] in a paper on "Refraction Without Cycloplegics" which he read before the Ophthalmological Society of the United Kingdom, claimed that from his many years of clinical experience, he found that the refractive results with a cycloplegic are no one whit better than those refracted without it. In many cases, he reported that less hyperopia was found after he used a 2 per cent solution of homatropine than when he refracted without it. Even in children he claimed that more accurate refraction can be obtained without the use of homatropine. He concluded the discussion with the statement that he was convinced from his long experience *that refraction without a cycloplegic was as accurate as that with one, if only correct methods were employed,* and if sufficient skill and experience were at the command of the refractionist.

It may also be interesting to note that Davis[8] discussing in the American Encyclopedia of Ophthalmology, the use of cycloplegics in refraction, holds similar views with Buttler on this subject. He claims that now fewer and fewer ophthalmologists than formerly are using cycloplegics as a routine method in every case of refraction. The main cause responsible for this drift away from the use of cycloplegics is the fact that improved objective methods of refraction have been developed and, says Davis, as time goes on there will be less call for the use of cycloplegics.

3. *The Use of a Cycloplegic from a Psychological Standpoint.*

Why are some refractionists at an absolute loss when refracting without the use of a cycloplegic? This condition is due to two facts.

1. The lack of training in making a thorough refraction by any other method. 2. In using a cycloplegic in refraction for any length of time one becomes adapted to this method and misses the cycloplegic findings when he has to refract without it. We grant the contention of some who claim that *they can not* make an accurate refraction unless they use a cycloplegic; this is due to their *type of training.* It does not however, prove that other refractionists *can not* perform an *accurate* refraction without the use of a cycloplegic.

The same is equally true when any refractionist has to omit any one of the tests he has been used to perform while making a complete refraction. There are some refractionists who claim that they would dispense with any instrument while refracting but the retinoscope or ophthalmoscope, or ophthalmometer and the use of any one of these instruments is just of as much importance to these refractionists from the standpoint of obtaining information as is the use of cycloplegic to others. That the law of adaption is an important factor in the continued use of cycloplegic I can testify not merely from the observation and experience of other rafractionists, but from my own personal experience as well. Some time ago I had an opportunity to come in close contact with many refractionists who were constant users of cycloplegics and I found that these refractionists were helpless when they tried to refract without it. Most of them could *not* make a thorough

and reliable preliminary manifest refraction. In most cases the manifest refraction consisted of merely taking the visual acuity before using the cycloplegic. This accounts for the great discrepancy they find between the manifest and cycloplegic refraction.

Another objection to the use of cycloplegics in refraction from a psychological standpoint is the fact that when the eye is under its influence the size of the black letters on the chart appear to be changed. Myer[7], an authority on experimental psychology, claims that "When the pupil is dilated under the influence of atropine, the size of the letters printed in black type is considerably reduced. This form of micropsia under atropine is likewise due to irradiation. It has been called 'micropsia at the fixation point.'"

Conclusion.

In carrying out this experiment and study and drawing the conclusions, I have not been influenced by any theoretical considerations advanced on this subject. The conclusions were drawn from the facts and figures as found from actual experience in conducting the examinations under the two different methods of refraction, the cycloplegic and manifest. A close study of the figures presented in tables 1 to 20, inclusive, and the analogy as presented in the summary of the preceding pages, will lead any unbiased observer to the following conclusions:

1. That there is more disagreement between the retinoscopic and subjective findings under a cycloplegic refraction than is found in the same kind used in a manifest refraction.

2. That the findings of a cycloplegic refraction are no more accurate than those of a manifest refraction.

3. That in most cases more accurate findings are obtained in a non-cycloplegic than in a cycloplegic refraction.

4. That experience and the use of proper methods are the most important factors in enabling the refractionist to obtain accurate results.

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SYMPTOMATOLOGY OF GLARE*

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During the many years devoted to investigation of photophobia and glare, a number of observations were made. Among these, the symptomatology revealed interesting facts.

On many occasions the writer stressed the significance of case histories.[1] From them many clues are derived. Our experience with patients leads us to expect certain possibilities. If our expectations clash with the true facts, we know that further checking is necessary. It is logical, therefore, that the patient's complaints should be given due consideration.

Many hypothetical and many experimental facts have been presented to readers of our professional publications. The greatest controversy seems to be over the subject of glare and its correction. The writer is not biased by these controversies, but presents his own views, which are not hypothetical but experimental from the practitioner's point of view. The question is not WHETHER tinted lenses should be prescribed or whether not; but WHEN such lenses should be prescribed and when not.

Since "Glare Diagnosis" is mostly subjective, and since instrumentation is limited, we turn to the case history and subjective tests as the most reliable source for information.

The patient's complaints should indeed give considerable information. Patients who will be relieved with glare absorption lenses will frequently observe themselves their need. They may tell us that shielding their eyes with their hands helps them to see better.[2] They may cite their experiences with light shade sunglasses in ordinary daylight. Patients may describe experiences whereby they found greater ocular comfort under subdued illumination. All of these facts can be used as guides for the diagnosis.

Very often patients will present complaints which will lead the optometrist to make certain conclusions. Extremely nervous people are often irritable to the least discomfort. Excessive lacrimation may and may not be relieved with absorption lenses, depending upon a number

*Submitted for publication Feb. 10, 1934.

of other factors. Squinting, especially outdoors, is a sign of light supersensitivity.

The patient's occupation is a further guide for the proper conclusion. For a person working under poorly illuminated conditions we have to prescribe entirely differently than for an individual working in a place where glare is evident.[3]

It is also necessary to study the patient's reactions throughout the entire examination. During the pupillary reflex tests the patient might complain of irritations they observe. While doing ophthalmoscopy, the quantity of illumination may have to be reduced in order to permit us to see the fundus without the patient's blinking, lacrimation and complaint of irritation. In retinoscopy it has been falsely observed by many, that upon flashing the light, the patient attempts to recline because of his photophobia. The writer prefers to contribute this to a nervous reflex instead, having very little to do with light sensitivity.

There has been considerable discussion regarding the size of pupils. This problem has not only been considered from the point of view of glare and photophobia, but also from the point of view of refraction. Just as much as small and large pupils are found in myopic eyes (which is contrary to the old school of teaching), both sized pupils can be found in photophobia. The size of pupils is controlled by the anatomic construction of a particular eye, and only rarely by outside influences such as refractive errors or photophobia.

Photophobia seems to be most prevalant among patients having high myopia, ptosis (upon correction), hay fever, and exophthalmic goiter.

After all the aforementioned symptoms are considered, they can be interpreted together with the subjective glare test.

The subjective glare test, which every refractionist should perform, is a simple test and requires no special expensive apparatus, and only very little time. After the best possible correction is obtained and the empirical prescription arrived at, an absorption lens (the writer uses Soft Lite No. 2 for this purpose[4]) is placed binocularly in front of each eye. If improvement of vision and/or softer vision (greater comfort) is reported by the patient, we are safe in prescribing an absorption lens for that individual.

Practical experience shows definitely that the problem of glare is becoming increasingly important. The writer predicted this a number of years ago in one of his treatises on evolution of glare.[5] Our present system of living places added burdens upon our eyes. The responsibility lies with us to be well prepared to correct these new conditions. The more we study problems in our offices, the more we realize the limited knowledge we possess on the subject of glare. We know what it is. We also know what photophobia is. We seem to know how to remedy these conditions. Then we must also find enough time in our routine exami-

nation to incorporate a glare test, whereby added comfort can be assured to the patient.

It is necessary, however, that we correlate all our data; i.e., case history, occupation, and subjective glare test. If we have a glarometer at our disposal, the information therefrom received can also be incorporated as a glare check test.

The symptomology of glare has its important place in the study of eye refraction.

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OCULAR SYMPTOMS IN CASES OF LOW AMOUNTS OF HYPEROPIA

It is safe to say that fully fifty per cent of all cases treated by optometric means are cases in which hyperopia plays some important part. In many of these cases the hyperopia is of low amount and it is surprising to find the relief from distressing symptoms which accompanies the correction of these small amounts of hyperopia. This is especially true when there exists a difference in the amount of hyperopia in the two eyes. These cases particularly, seem to suffer symptoms all out of proportion to the amount of refractive error usually found, and for this reason require the most painstaking attention.

One of the chief symptoms of this type of uncorrected ametropia is the frontal headache. According to Wiseman[1] the amount of uncorrected defect is no criterion, because relief is often obtained by means of the weakest lenses used. This type of headache is the most common form of headache which we as optometrists encounter, particularly the low, supra-orbital variety. Patients so afflicted complain that the pain is just over the eyes or in and through the orbits.

[1] Wiseman, E. G. Ocular Symptomatology. Professional Press. 1924. p. 85.

In addition to this symptom of frontal headache there is the type of eye-aching pain usually described as burning, or pricking. These sensations tend to make the patient want to rub the lids and to produce the symptoms of soreness and ocular irritation which frequently accompanies hyperopia that is uncorrected.

Another of the typical symptoms of hyperopia of low amount is the complaint so frequently heard regarding the inability of the patient to do much reading or sewing or studying with comfort. These patients complain of an increasing intolerance to do prolonged near-point work and the correction of but small amounts of hyperopic error frequently brings relief to these patients.

Photophobia is another of the symptoms frequently complained of by patients suffering from uncorrected amounts of hyperopia of small degree. Most of these sufferers complain that on going out of doors after doing near-point work the light hurts their eyes. Questioning will develop the fact that this is frequently true even on dull days or in the late afternoon when such symptoms are usually not in evidence. Photophobia of this type is a neurological syndrome of ocular fatigue and subsides when the small accommodative stress has been relieved.

Turville[2] adds another symptom to the foregoing. He reports that occasionally patients report work being performed in a faulty manner and that patients complain that straight lines on objects tend to become bent. While the writer has not associated this symptom with small amounts of uncorrected hyperopia it may be well to do so in the future, particularly when the case history is being taken.

Uncorrected hyperopia, especially when the amount of the error is greater in one eye than in the other is a serious ocular abnormality. If long neglected the general symptoms of nervousness and irritability appear. Patients complain of being easily tired and their mental outlook is depressed. Optometry holds much that can be done for these sufferers and it is our duty to give these apparently simple cases the same thorough-going care and attention that is usually accorded the more complex cases where involvements of the extra-ocular muscles are found.

C. C. K.

* * * * *

OCULAR MANIFESTATIONS IN DIABETES

There are numerous ocular disturbances caused by diabetes. W. H. Gray in an article on this subject in the October 1933 issue of the British Journal of Ophthalmology claims that he examined 583 cases and that the number of cases in this group which manifested arterio-sclerosis indicates that diabetes causes degenerative changes in the vascular system. It is certainly not the sole factor in causation, since degenerative change appear to be absent in the young. Even slight evidence of vessel change

[2] Turville, A. E. Hyperopia. The Dioptric Review. Vol. 35, No. 5, p. 279.

in the retina is important, however, because it indicates that more pronounced changes may exist elsewhere. Diabetic retinitis is a well-known phenomenon, the signs being retinal exudates and haemorrhages, either in combination or alone. Out of 500 diabetics these signs were observed in sixty-six cases. They are sometimes, but not always, associated with high blood pressure and albuminuria, but not specially with arteriosclerosis. A characteristic form begins with whitish-yellow spots in the central part of the retina.

In most of the diabetic patients who develop cataract it is indistinguishable from ordinary senile cataract. Rarely, however, a peculiar form consisting of small subcapsular opacities may be observed. This true diabetic cataract occurs in young patients with severe diabetes; in this series only two such cases were seen. The average age of those developing ordinary senile cataract appears to have been lower than is the rule in non-diabetic cases; moreover, a history of septic infection was not uncommon. Ocular palsies are known to be liable to occur in diabetics; according to Gray no muscle supplied by the third, fourth, or sixth nerve is exempt, while the sixth nerve seems to be especially vulnerable. No mention is made of changes in the refraction of the ocular media which have been observed in diabetes and which are usually of a temporary nature. Otherwise his review is very complete. It is satisfactory to be assured once again of the value of insulin medication for diabetics undergoing ophthalmic operations. The prognosis of cataract needlings and extractions in diabetics is said to be as favorable as in healthy members of the community. J. I. K.

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BOOK NOTICES

ATLAS OF EXTERNAL DISEASES OF THE EYE. Humphrey Neame, F.R.C.S. Published by P. Blakiston's Son & Company, 1012 Walnut St., Philadelphia. Penna. 111 pages, 51 colored plates. Cloth. $5.00, 1934.

This small volume by Neame bears the same relationship to the external ocular inspection of the Eye, that Haab's Atlas of Ophthalmoscopy does to a study of the media and fundus. Neame presents 51 beautifully done color plates, showing various pathological conditions of the anterior surface of the eye and lids. These plates are divided into four groups as follows: The Eyelids and Lacrymal Apparatus; the Conjunctiva; the Cornea and Sclerotic; and the Iris, Lens and Ciliary Body.

Facing each color plate is a printed page devoted to the abnormality illustrated, giving the symptoms, diagnosis, Aetiology, pathology, course, prognosis and treatment of the condition. Words cannot express the

general excellence of this new work by Neame. Every practicing optometrist should have a copy of this book in his refracting room, at hand for immediate reference. C. C. K.

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OCULAR DIOPTRICS AND LENSES. G. F. Alexander, M.B., C. M. Edin. Published by the Williams & Wilkins-William Wood and Company. Mount Royal and Guilford Ave., Baltimore, Maryland. 216 pages, illustrated, $4.75. 1934.

The chapters dealing with the mechanism of accommodation, the dynamic refraction of the Eye and the anomalies of accommodation are the most original and important in this new work by Alexander. In his chapter on the mechanism of accommodation the author develops a somewhat new theory of accommodation, considerably at variance with that of Helmholtz. While we cannot entirely agree with Alexander in his reasoning, his postulate evidences a considerable amount of research on the subject and indicates also that he has approached the subject of accommodation with an open mind, which in itself, is both refreshing and essential when scientific work is to be done.

Most authors and almost all refractionists have the tendency to regard this matter of the mechanism of accommodation as a closed subject, upon which everything that can be said, has been said. In this they are in error, as at best, our theories of accommodation are but theories, not as yet irrevocably proven.

Alexander, in dealing with the anomalies of accommodation lists some nine causes for either the partial or total loss of accommodation. One of these is new to the reviewer. Alexander says, "an insufficiency may be due to an anaemia caused by repeated child-bearing." He fails to state, however, just how many children must be carried before this phenomena sets in. And, if the number is at all large, just how he goes about differentiating this loss of accommodation, from the normal presbyopia which would inevitably accompany the bearing of "large-numbers" of children, due to the years that would necessarily elapse while large numbers were being carried. However, aside from this, the chapter is of interest and is one of the best in the book and gives the authors own views whether or not they clash with accepted theories.

Most of the book is taken up with the geometrical optics of refraction and the mathematics of simple and compound refracting lens systems. The small portion of the book devoted to ocular refraction is most elementary. The author devotes considerable time to the important matter of the effective power of a lens before the Eye, stressing the importance of placing the lens the proper distance from the anterior surface of the cornea. This was Dean Ernest Petry's pet hobby at the Rochester School of Optometry and as Petry has frequently said, the matter is of far more importance than usually recognized.

This work by Alexander is recommended for the optometrist interested in research work in the field of ophthalmic-lens-optics and for the student and practitioner who enjoys his mathematics. C. C. K.

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REPORT OF THE TRANSACTIONS OF THE TWELFTH ANNUAL MEETING OF THE AMERICAN ACADEMY OF OPTOMETRY. Vol. VIII. First Edition limited to 150 copies. Edited by Carel C. Koch. Published by the American Journal of Optometry, Foshay Tower, Minneapolis, Minn. Sold only through the Secretary's Office of the Academy. (Dr. J. Fred Andreae, Lexington Bldg., Baltimore, Maryland.) $10. 206 pages. 46 illustrations. Cloth. 1934.

Volume eight of the set of Academy year books is just off the press. In appearance it is much like the volumes which preceded it, yet in content matter it is without question the most excellent of all Academy Year Books. This is due to the splendid work done in arranging the program by Dr. Edwin Forbes Tait, who also supervised the preparation of the actual material presented at the meeting itself and who rejected all papers not up to present day Academy standards.

Like the preceding volumes, this year's book is largely technical. The papers which are published represent the major part of the material given before the Academy during its three-day session in Baltimore last December. Following each paper will be found a short report of the discussion which followed each presentation, as the papers were delivered before the Academy.

The following papers will be found in this volume. The titles are given in the order in which they appear in the book. The Chairman's Address by O. J. Melvin, (pp. 11-12); The Secretary's Report and Committee Reports by J. Fred Andreae, (pp. 13-16); The Optical correction of a case of Homonymous Hemianopsia by Charles E. Jaeckle, (Ill. pp. 17-25); A study of the factors entering into the determination of Handedness by Lewis H. Kraskin, (pp. 26-31); Bichrome refraction by E. LeRoy Ryer and Elmer E. Hotaling (Ill. pp. 32-57); Report of 500 cases of sub-normal vision by William Feinbloom, (pp. 58-70); Sub-normal vision from infancy—a case report by Charles E. Jaeckle, (Ill. pp. 71-83); The non-operative treatment by Strabismus by R. M. Hall, (Ill. pp. 84-116); The clinical significance of differences in the relative size and shape of Ocular Images by Howard C. Doane, (pp. 117-133); A further report on Ptosis Crutches by John C. Neill, (Ill. pp. 134-140; Sub-normal Vision Committee Report by Ryer, Melvin and Hotaling, (pp. 141-142); A discussion on "Procedure in Discussion" by Edwin Forbes Tait, (p. 143); Report of the Fellowship Committee by Edwin Forbes Tait, (pp. 144-146); Report of the use of Red-Free Glass in certain Cataract cases by Elmer E. Hotaling and E. LeRoy

Ryer, (pp. 147-154); An experimental investigation of the negative fusional convergence amplitude by William J. Tait, (Ill. pp. 155-167); The distribution of the tonic reciprocal innervation to the extra-ocular muscles in over 2000 clinical cases by W. O. Vivian, (Ill. pp. 168-175) and The causative and interpretational factors in Corneal Astigmatism by George A. MacElree and John F. Morrow, (Ill. pp. 176-195).

In looking over these manuscripts one is impressed with the thoroughness in which these authors have developed each subject and one is also impressed with the advancement made during the last year, as many of the papers deal with technics and therapies reported on in previous volumes. Each contributor to this annual volume of the Academy may well feel that he has made a real contribution to the literature of our profession.

C. C. K.

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SEEING AND HUMAN WELFARE, by Mathew Luckiesh, D.Sc. Published by the William & Wilkins Co., Baltimore, Md. 193 pages, $2.50. 1934.

In this book "Seeing and Human Welfare," Luckiesh tried to present some of his work in a non-technical manner. Much of the material in this book is contained in his book "Seeing, a Partnership to Lighting and Vision" but here it is lifted out of its technical setting and put in more simple language for laymen.

In his chapter on the human seeing machine he relates an interesting experiment conducted in his laboratory to measure the nervous muscular tension developed by ordinary visual tasks under different conditions of seeing. He points out that as a result of this experiment a visual task may be performed more easily as the seeing conditions are improved far above those under which the task can barely be performed. It was also found that the speed of reading was considerably increased with the increase of illumination.

The Science of Seeing, Luckiesh contends, must deal with three major complexities, namely:

1. The external world of physical factors.
2. The eyes, Visual sense, and successive events of visual response.
3. The psycho-physiological effects pertaining to human behavior. efficiency, welfare and happiness.

All through the book the author stresses the importance of the psychological factors of seeing, which have either been overlooked by former investigators or else have attached to them very little importance.

J. I. K.

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